



LAWRENCE
LIVERMORE
NATIONAL
LABORATORY

Soft radiative strength in warm nuclei

A. Schiller, A. Voinov, U. Agvaanluvsan, E. Algin, J. A. Becker, T. Belgya, L. A. Bernstein, R. Chankova, P. E. Garrett, M. Guttormsen, G. E. Mitchell, R. O. Nelson, J. Rekstad, S. Siem

March 12, 2004

International Nuclear Physics Conference
Goteborg, Sweden
June 27, 2004 through July 2, 2004

Disclaimer

This document was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor the University of California nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or the University of California, and shall not be used for advertising or product endorsement purposes.

Soft radiative strength in warm nuclei

A. Schiller^{1,2}, A. Voinov³, U. Agvaanluvsan^{2,4,5}, E. Algin^{2,4,5,6}, J.A. Becker², T. Belgia⁷,
 L.A. Bernstein², R. Chankova⁸, P.E. Garrett², M. Guttormsen⁸, G.E. Mitchell^{4,5},
 R.O. Nelson⁹, J. Rekstad⁸, S. Siem⁸

¹ NSCL, Michigan State University, East Lansing, MI 48824

² Lawrence Livermore National Laboratory, L-414, 7000 East Ave., Livermore, CA 94551

³ Frank Laboratory of Neutron Physics, JINR, 141980 Dubna, Moscow Region, Russia

⁴ North Carolina State University, Raleigh, NC 27695

⁵ Triangle Universities Nuclear Laboratory, Durham, NC 27708

⁶ Department of Physics, Osmangazi University, Meselik, Eskisehir, 26480 Turkey

⁷ Institute of Isotope and Surface Chemistry, HAS, H-1525 Budapest, Hungary

⁸ Department of Physics, University of Oslo, N-0316 Oslo, Norway

⁹ Los Alamos National Laboratory, MS H855, Bikini Atoll Rd., Los Alamos, NM 87545

Contact e-mail: schiller@nscl.msu.edu

Unresolved transitions in the nuclear γ -ray cascade produced in the decay of excited nuclei are best described by statistical concepts: a continuous radiative strength function (RSF) and level density yield mean values of transition matrix elements. Data on the soft ($E_\gamma < 3\text{--}4$ MeV) RSF for transitions between warm states (i.e. states several MeV above the yrast line) have, however, remained elusive [1].

A combination of two experiments on the same residual nucleus [2] can provide such data. This involves (i) deriving the level density and the sum (over all multiplicities) of all RSFs by sequential extraction from primary γ spectra [3] and (ii) measurements of two-step-decay spectra following neutron capture [4] which are roughly proportional to the product of two RSFs.

The very first two investigations (on ^{172}Yb and ^{57}Fe) have produced unexpected results. In the first case, a strong ($B(M1 \uparrow) = 6.5 \mu_N^2$) resonance at $E_\gamma = 3.3$ MeV was identified. In the second case, a large (up to factor ~ 10) enhancement compared to theoretical estimates of the very soft ($E_\gamma \leq 3$ MeV), summed RSF for transitions between warm states was observed.

This work has benefited from the use of the Los Alamos Neutron Science Center at the Los Alamos National Laboratory. This facility is funded by the U.S. Department of Energy under Contract W-7405-ENG-36. Part of this work was performed under the auspices of the U.S. Department of Energy by the University of California, Lawrence Livermore National Laboratory under Contract W-7405-ENG-48, and Los Alamos National Laboratory under Contract W-7405-ENG-36. Financial support from the Norwegian Research Council (NFR) is gratefully acknowledged. Part of this work was supported by the EU5 Framework Programme under Contract HPRI-CT-1999-00099. A.V. acknowledges support from a NATO Science Fellowship under project number 150027/432. G.M. and U.A. acknowledge support by U.S. Department of Energy Grants No. DE-FG02-97-ER41042 and DE-FG03-03-NA00076.

1. Yu. P. Popov, Sov. J. Part. Nucl. **13** (1982) 483.
2. A. Voinov et al., Nucl. Instrum. Meth. **A497** (2003) 350.
3. A. Schiller et al., Nucl. Instrum. Meth. **A447** (2000) 498.
4. S. T. Boneva et al., Sov. J. Part. Nucl. **22** (1991) 698.